



GCE MARKING SCHEME

**BIOLOGY/HUMAN BIOLOGY (NEW)
AS/Advanced**

JANUARY 2010

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2010 examination in GCE BIOLOGY/HUMAN BIOLOGY (NEW). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

BY1

1.

	DNA	RNA
Contains a pentose sugar	✓	✓
Found in the nucleus	✓	✓
Thymine is never present	x	✓
Consists of a double helix	✓	x
Molecules short lived	x	✓
Associated with ribosomes	x	✓

[Total 6 marks]

2.

	Structural feature	Function of feature
Organelle		ribosome manufacture / synthesis rRNA;
Mitochondrion;		<u>Increase surface area</u> for enzyme attachment /ATP synthesis/ oxidative phosphorylation;
Lysosome;		
	stack of cisternae / flattened (membrane bound) sacs	Protein assembly /conjugation of proteins / secretion / lysosome formation/ produces vesicles/packaging or modification molecules/ stores and transports lipids/stores and transports lipids

[Total 6 marks]

3. (a) (i) alginate beads / gel membrane / meshwork of inert material /
cellulose (not: entrapment unqualified) [1]
- (ii) product easily recovered/not contaminated by enzyme;
so cheaper to use;
greater stability;
despite variations in/higher temperature / pH;
enzyme easily removed / added;
can control rate.
more than one enzyme can be used [3]
- (b) (i) allows urea to pass through;
prevents passage of blood cells / other molecules/solutes;
so they can't affect results / enzyme / reduce enzyme activity. [2 max]
- (ii) absorb/ref. ammonium ions;
converts into an electrical signal / changes chemical to electrical signal;
to record levels of urea. [2]
- (c) increased temperature increases enzyme activity/rate of reaction;
more ammonium ions formed;
greater electrical current generated;
reference fair testing. [2 max]
- (d) diabetes. [1]

[Total 11 marks]

4. (a) (i) arrow drawn pointing clockwise; [1]
 (ii) segment drawn after telophase of roughly similar dimensions [1]

- (b) replication of DNA;
 increase in cell size;
 chromosomes exist as chromatids;
 replication of organelles/centrioles;
 synthesis of ribosomal material;
 synthesis of ATP;
 synthesis of protein [4 max]

- (c) (i) metaphase; [1]
 (ii) anaphase [1]
 (iii) anaphase; [1]
 (iv) prophase; [1]
 (v) telophase. [1]

[Total 11 marks]

5. (a) (i) C to B to A; [1]
 (ii) water moves down a water potential gradient / high to low;
 by osmosis; (not: ref. water concentration)
 reference actual figures on diagram; [2]

- (b) (i) $\Psi = +1000 - 1800$;
 $= - 800\text{kPa}$ [2]
 (ii) plasmolysed; [1]
 cell in concentrated solution / low water potential;
 water passes out;
 cytoplasm/vacuole shrinks. [2 max]
 (not: cell membrane comes away from wall)

- (c) (i) water passes into cell by osmosis;
cytoplasm expands;
cell becomes turgid;
as cytoplasm / contents push against wall;
wall inelastic / resists further expansion. (not:rigid) [3 max]
- (ii) wilts. (not: dies) [1]

[Total 12 marks]

6. (a) (i) nitrogen containing part; [1]
- (ii) arrow pointing to glycosidic bond; [1]
- (iii) hydrolysis; [1]
- (iv) hydroxyl groups point outwards;
link with neighbouring chains;
via hydrogen bonding;
to form microfibrils;
strong structure because of large number of hydrogen bonds;
chains associate in groups / fibres formed;
beta glucose units. [3 max]
ref. alternating rotation
- (b) (i) tertiary; [1]
- (ii) links between different parts of polypeptide chains;
produces a specific shape for the molecule / lysozyme;
reference to active site;
complementary to substrate;
allows enzyme – substrate complexes to form; [3 max]

- (c) (i) mass/volume of tissue/sample; (not: amount/size)
concentration of hydrogen peroxide;
same time intervals between measurements;
equal volumes of hydrogen peroxide used;
pH;
temperature. [2 max]
- (ii) most metabolically active;
produces most hydrogen peroxide;
needs to be broken down because of toxicity; [2 max]

[Total 14 marks]

7. (a) A. Singer Nicholson / fluid mosaic model; [1]
B. Phospholipids / lipid bilayer; [1]
C. Separate contents from outside / acts as barrier; [1]
D. Phospholipid allows fat soluble substances through / selective; [1]
E. Hydrophobic / water hating tails face each other; [1]
F. Hydrophilic / water loving heads face water / outwards; [1]
G. Carrier protein; [1]
H. Used for active transport; [1]
I. Specific substances transported; [1]
J. Cholesterol affects fluidity; [1]
K. Channel/carrier protein for facilitated diffusion; [1]
L. some are enzymes; [1]
M. Hydrophilic channels; [1]
N. Glycoprotein / glycolipid; [1]
O. For cell recognition/signalling/hormone recognition. [1]

[Total 10 marks]

7. (b)
- A. Energy storage; [1]
 - B. Release more energy per unit mass than carbohydrates; [1]
 - C. Makes seeds lighter / smaller for dispersal / energy store for hibernation; [1]
 - D. Phospholipid component of cell membrane; [1]
 - E. Controls entry of molecules into cell; [1]
 - F. Insulation; [1]
 - G. Protection of (delicate) organs or e.g.; [1]
 - H. Buoyancy for aquatic animals or e.g.; [1]
 - I. consist of the elements carbon hydrogen and oxygen; [1]
 - J. Glycerol plus three fatty acids; [1]
 - K. Joined by condensation reactions; [1]
 - L. Via ester bonds; [1]
 - M. saturated and unsaturated fatty acids; [1]
 - N. phosphate group present in phospholipids [1]
 - O. water proofing+ wax/oils;hormones+ steroids;
myelin sheath + insulation; AVP

Any 5 structure i.e. points B, D, E, I to N and 5 others

[Total 10 marks]

BY2

1. One mark for each line:-

Animalia: Fungi: Protoctista: Plantae: Prokaryotae. [5]
(no mark if extra ticks present)

[Total 5 marks]

2. (a) Wings of birds and bats. [1]

(b) (i) Adaptive radiation (**Allow** Speciation / Natural Selection) [1]

(ii) No competition from other birds / vacant niches / subsequent
intraspecific competition (Any two) [2]

(c) Unable to interbreed and produce fertile offspring [1]
(allow: breed together. Not: unable to breed)

(d) DNA profiling/hybridisation (comparing DNA or equivalent e.g. fingerprinting)
(not: looking at DNA/electrophoresis unqualified) [1]

[Total 6 marks]

3. (a) (i) Larger caecum in rabbit. [1]

Longer intestine in rabbit [1]
(allow: longer rectum in rabbit. Not: ref. pancreas)

(ii) Human is omnivorous / mixture of meat and plant food [1]

(b) Rabbit – premolars and molars with large cusps or for grinding / no
carnassials / large incisors / no canines (not: ref. continuous growth)
Cat – carnassials / loss of back molars / shape of incisors / large canines.

(Three comparisons) [3]

(c) Mammals are unable to digest cellulose / do not possess a cellulase. [1]

Bacteria can break down the (very high proportion of) cellulose in the rabbit
diet. [1]

(d) (i) Effectively doubles the exposure to cellulose digestion. Gives more
time to absorb nutrients. [1]

(ii) Cows have (four) more than one stomach(s). [1]

Food is regurgitated for further grinding/chew the cud. [1]

Additional stomachs for bacterial fermentation. [1]

[Total 12 marks]

4. (a) Large surface area / thin or short diffusion pathway / permeable / good blood supply
(moist neutral; wrong answer negates right answer; not: ref. contraflow)
(Any three) [3]
- (b) On diagram B label water (upper plot) and blood (lower plot) with arrows pointing left to right on both [1]
- Water plot starts high on Y axis (90-100%) and blood starts low (20%) [1]
- Convergence point is at 50%. [1]
- (c) X = distance along lamella / gill plate (not gill). [1]
- (d) Blood saturation reaches higher level. [1]
- Uptake continues (water concentration higher than blood) throughout/
concentration gradient maintained. [1]
- [Total 9 marks]**
- 5 (a) In combination with haemoglobin /as carbamino-haemoglobin. [1]
- Dissolved/in solution in the plasma. [1]
- (b) (i) Carbonic anhydrase. [1]
- (ii) speeds up the reaction. [1]
- (c) (i) They pass (out of the corpuscle) into the plasma. (not: blood) [1]
- (ii) They dissociate oxyhaemoglobin to release oxygen [1]
- To be used in respiration by the muscle. [1]
- (iii) Chloride/ Cl^- (not: chlorine) [1]
- Enters the corpuscle to replace bicarbonate/ in order to preserve electrical neutrality. [1]
- (d) Causes acidification in fresh and seawater. [1]
- Extinction of fish in lakes / death of coral reefs / failure of shell formation in shellfish / any sensible suggestion based on aquatic fauna or flora. [1]
- (not: affects organisms in the water)

[Total 11 marks]

6. (a) Choice of suitable scale with axes the right way round [1]
 Correct units on axes (hrs, gh^{-1} , or g/h) [1]
 Accurate plotting of points (+/- half small square). [1]
 Quality of line, no extrapolation. [1]
- (b) Quantitative comparison e.g. actual values at the two times or value at 1600 is 5 times the value at 0800 [1]
 Mention of difference in light intensity at the two times. [1]
 Relate this to photosynthesis of K^+ pump. [1]
 Causing opening of stomata / movement apart of guard cells. [1]
- (c) Increasing the temperature / lowering the humidity / air movement.
 (not: heat) (*ignore light – conference*) (Any two) [2]
- (d) (i) Cohesion is the strong attraction that water molecules exert on one another. (not: stickiness) [1]
 (ii) Water molecules evaporating through the stomata/transpiration at the top of the column are replaced from below [1]
 and because of cohesion this creates an upward force (tension) throughout the whole column. [1]
 (iii) Adhesion between the water molecules and the xylem wall. (allow: ref. cellulose/lignin. Not: friction/capillarity) [1]
- (e) (i) Root Pressure. [1]
 (ii) Active transport of ions into the root xylem. [1]
 Creates an osmotic (wp) gradient / water is drawn in by osmosis at the foot of the xylem. [1]

[Total 17 marks]

7. (a) A. Heart muscle is myogenic. [1]
(allow: heart is myogenic, conference only)
- B. It can contract without any nerve stimulation. [1]
- C. The stimulus to contract originates in the sinoatrial node (SAN). [1]
- D. Which controls the rate of beating / acts as pacemaker. [1]
- E. It is situated in the wall of the right auricle / atrium. [1]
- F. Electrical impulse from the SAN causes the two auricles / atria to contract. [1]
- G. Thin layer of connective tissue prevents the stimulus spreading to the ventricles. [1]
- H. At the bottom of the wall separating the two auricles / atria is the atrioventricular node AVN. [1]
- I. This delays the impulse (about 0.1 sec) before passing it on to the ventricles. [1]
- J. The impulse is sent to the tip/apex of the ventricles [1]
- K. Along bundle branches (Bundle of His); [1]
- L. And is conveyed upwards along the branching Purkinje fibres [1]
- M. Causing a wave of ventricular contraction starting from the lowermost part of the ventricle; [1]
- N The SAN may be stimulated by various factors to change its pacing [1]
- O. One example – hormones (adrenalin), exercise, body temperature, etc. (allow: ref. autonomic nervous system) [1]

[Ten marks can be awarded from the fifteen available]

7. (b)
- A. Gametes are shed in water [1]
 - B. and fertilisation is external. [1]
 - C. Heavy waste of gametes which fail to fuse. [1]
 - D. Embryo is entirely dependent on yolk supply for its development. [1]
 - E. Many hazards – predation etc, - large waste of embryos. [1]
 - F. Finding suitable conditions for development is a completely random process. [1]
 - G. Terrestrial mammals have internal fertilisation. [1]
 - H. Placing of gametes/female gametes not shed. [1]
 - I. Greater certainty of fertilisation. [1]
 - J. Number of eggs has been much reduced. [1]
 - K. Internally developing embryo not dependent solely on yolk / importance of placenta. [1]
 - L. High level of protection from external hazards during development. [1]
 - M. In general more time / energy / resources devoted to fewer offspring. [1]
 - N. Contact between parent and offspring; parental care [1]
 - O. e.g. provision of dens/burrows/herding/ protection from predation etc. [1]

[Ten marks can be awarded from the fifteen available]

HB2

1. salivary glands [1]
 amylase [1]
 crypts of Lieberkühn / villus (not: Brunners glands) [1]
 glucose [1]
 fructose [1]

[Total 5 marks]

2. (a) 3, 5, 6, 2, 7, 1, 4 [1]
- (b) (i) Each organism is given two names / genus and species; [1]

 An internationally recognised system / a precise identification
 world-wide. [1]

 (iii) *Homo sapiens* (**not** *H.sapiens*) [1]
- (c) (i) C / palaeontology
 (ii) F / extinction
 (iii) B / evolution
 (iv) A / biodiversity
 (v) H / speciation [5]

[Total 9 marks]

3. (a) (i) A – red blood cell / erythrocyte
 B – epithelial [2]
- (ii) prevents lining of alveolus sticking together / prevents alveoli
 collapsing / reduces surface tension / reduces cohesive nature of
 water molecules.
 (**not** keep alveoli open/lubricate) [1]
- (iii) (to assist breathing in) premature babies [1]

- (b) (i) Trace D is showing; (or converse).
1. deeper breaths
 2. more frequent breaths [2]
- (ii) 14 [1]
- (iii) 500 cm³ [1]
- (iv) (Tidal) volume breathed in / out would be less /
Time taken for each breath would be longer [1]

[Total 9 marks]

4. (a) (i) Blood goes through / pumped by heart twice (for each circuit of the body); reference to pulmonary or systemic circulation
(any two) [2]
- (b) A – vein
B – artery [1]
- (c) (i) B;
A;
E. [3]
- (ii) one cell thick; to allow for diffusion.
OR narrow diameter; to reduce blood flow / low pressure /
to enable exchange of materials. (not: thin) [2]

[Total 8 marks]

5. (a) (i) Supplies heart muscle; [1]
with oxygen / glucose/for respiration [1]
- (ii) Smoking, diet high in saturated fat; high cholesterol / LDL's;
too much salt (in diet) / too much alcohol (in diet); (**not** unhealthy diet)
Lack of exercise; stress (any three) [3]

- (iii) Fat deposit built up / lines the wall; [1]
 taken up from the blood/from cholesterol in the blood; [1]
 (not: cholesterol deposits)
- (iv) If blood is prevented from passing through (a coronary artery); [1]
 the heart muscle stops beating / contracting; resulting in a
 heart attack / myocardial infarction [1]
- (b) a small balloon is threaded / inserted into the (partly blocked)
 (coronary) artery (through a tube);
 it is then inflated and as it expands it presses against the atheroma (and
 makes one or two tears in it); the lumen is restored to (something like) its
 normal width; the
 (deflated) balloon is removed. (any two)
 This relieves the resistance to blood flow (experienced during
 exercise)/allows blood to flow more easily [3]

[Total 12 marks]

6. (a) Mention of (natural) barrier to prevent entry of pathogens;
 Natural skin flora preventing growth of pathogens.
 Skin pH preventing growth of pathogens (any two) [2]
- (b) Increase in diameter / vasodilation of blood vessels (for increased transport);
 phagocytosis / bacteria engulfed by phagocytes;
 blood clotting / scab formation to seal wound;
 new cells replace damaged tissue;
 mast cells production of histamine. (any three) [3]
 (not: reference to production of antibodies)

[Total 5 marks]

7. (a) (i) An (infectious) disease always present at low levels (in an area) [1]
- (ii) Snail [1]
- (iii) Eggs pass out in (human) urine / faeces and larvae bore into snail [1]
- (iv) Snail / parasite lives in water;
larvae / parasites penetrate exposed worker's skin. [2]
- (b) (i) The greater the *Schistosoma* infection/number of eggs in the urine the greater the incidence of anaemia [1]
- (ii) Parasite destroys / feeds on red blood cells / erythrocytes
Internal bleeding / blood vessels damaged. [1]
- (iii) Iron deficiency / vitamin B12 / failure to absorb iron /
heavy menstruation [1]
- (iv)

	Schistosoma parasite	Malarial parasite
Method of entry of the parasite into the human body	(Bores) through the skin	Mosquito bite
Where in the human body the parasite is mainly found	In blood vessels (not in blood cells)	In liver / red blood <u>cells</u>

[4]

[Total 12 marks]

8. (a) Vaccination essay

- A. antigens
- B. stimulate an immune response / lymphocytes recognise these as non-self
- C. weakened / attenuated virus owtte (not: dead pathogens)
- D. antibodies are produced
- E. specific/complementary to antigen
- F. B lymphocytes / plasma cells stimulated to produce primary response/plasma cells
- G. and memory cells
- H. If the same antigen / pathogen enters the body / circulation / reinfection memory cells recognise the antigen and immediately produce antibodies
- I. to a higher level and quicker
- J. these destroy the pathogen before the person becomes ill / secondary response

[Any 7 from 10]

Some marks can be awarded from an annotated graph.

- K. Some pathogenic diseases / smallpox have been eliminated
- L. Influenza virus / malarial parasite mutates and cannot be eliminated by vaccination
- M. Increased global travel spreads infection / no cure for viruses / droplet infection difficult to control
- N. Animal reservoirs / e.g. unvaccinated boys – *Rubella*.
- O. Reports of possible side-effects (MMR) reduce take-up of vaccination in children.

[Any 3 from 5]

8. (b) Cell mediated immune response essay

- A. The response involves T-lymphocytes (not: T cells , allow ecf)
- B. T cells develop / mature in the thymus gland
- C. Each T-cell has receptors for its specific antigen
- D. Macrophages engulf the pathogens (having antigens on their surface)
- E. Specific T-lymphocytes recognise and fit with the antigen
- F. T-lymphocytes multiply by mitosis/rapidly/ produce a clone
(each cell of which recognises the antigen as non-self)
- G. There are three types of T-cell – T killer cells, helper cells,
suppressor cells and memory cells (any 3)
- H. Function of killer cells, directly kill cell (infected by virus) / cancer cells
(not: pathogen)
- I. Helper Tcells activate B-lymphocytes to (initiate an antibody response)
- J. T suppressor cells switch off immune system when antigen no longer
Present
- K. on reinfection memory cells recognise the antigen and immediately
produce antibodies

[Any 7 from 10]

- L. Virus attacks and destroys helper T cells / low helper T cell count
- M. Virus may remain latent for many years before being activated,
when it will start to multiply and destroy the host cell
- N. This reduces the body's ability to fight disease / weakens immune
system
- O. One symptom – weight loss and diarrhoea, cancer, deteriorating
brain function/the most common form of death in AIDS is a rare form
of pneumonia.

[Any 3]

BY4

1. (a) A = Coccus
B = Bacillus
C = Spirillum [3]
- (b) Gram +ve violet/purple (not:blue)
Gram –ve red [1]
- (c) Facultative anaerobes, grow better in presence of oxygen but can survive without it; [1]
Obligate anaerobes, cannot survive in presence of oxygen. [1]
- (d) (i) do not put culture bottle cap onto bench;
flame mouth of tube;
flame (inoculating) loop;
lift Petri dish lid at an angle;
(not: in context of pouring plate)
use a pressure cabinet / sterile cabinet / near Bunsen for updraft;
(not: use sterilised Petri dishes/autoclave/equipment)
[Max 4]
- (ii) Sealed: anaerobic conditions encourage pathogenic bacteria; [1]
Body temperature: encourages (human) pathogenic bacteria. [1]
- (e) (i) B, clear distinct colonies which can be counted / A too many colonies / merged, to count accurately, C not enough; [1]
- (ii) Plate B 200 bacteria per cm³,
B was diluted by hundredfold twice dilution factor of 10000;
 $200 \times 100 = 2 \text{ million} / 2 \times 10^6$;
1 mark for method look for 200 and 10000,
Give 2 marks for 2 million [2]

2. (a) P = phosphate (not: phosphoric acid)
 Q = nitrogenous base / organic base / adenine;
 R = Ribose / pentose (sugar). [3]
- (b) (i) Supplies energy; all reactions; in all cells; [Max 2]
 (not: produces)
- (ii) Soluble; easily transported across membranes; easily hydrolysed;
 energy released in useable amounts; several methods of
 regeneration; link between energy production and energy use; only
 one enzyme needed [Max 3]
- (c) Glycolysis; glucose to pyruvic acid/ pyruvate; (ATP produced) substrate level
 phosphorylation; pyruvic acid converted into lactic acid (accept ethanol); from
 reduced NAD; so that NAD regenerated; allows glycolysis to continue.
 (not: NADP/glucose to lactic acid/ref. number ATP produced) [Max 4]
3. (a) A = Grana / thylakoid membranes;
 B = Stroma;
 A = Grana / thylakoid membranes;
 B = Stroma;
 C = Starch grain, clear area in chloroplasts; [5]
- (b) (i) P = light energy / photons of light;
 (ii) Electron acceptors/carriers;
 (iii) Electrons flowing along an electron transport chain / cytochromes;
 (not: chemiosmosis)
 (iv) Oxygen
 (v) NADP / NADPH⁺ / reduced NADP / NADPH₂;
 (vi) Electrons from photolysis replacing electrons in chlorophyll of PS II [6]
- (c) a. Light dependent reactions do not take place – in correct context;
 b. ATP;
 c. reduced NADP not produced;
 d. Calvin cycle stops; (not: dark reactions)
 e. GP not converted into TP/GALP;
 f. no hexose sugar made;
 g. no respiratory substrate / respiration stops [Max 5]

4. (a) Transmit impulses between neurones / from neurone to muscle;
(not: signal)
One direction only / polarity;

Filter out low level stimuli/background;

Protect from over stimulation;

(Act as junctions) / additive effect of stimuli from different neurones/ Spatial summation;

Accept reference to inhibitory synapses;

Temporal summation; [Max 3]
- (b) Nerve net, neurones shorter; branched; can transmit in both directions;
facilitation; slower transmission; Stimuli pass in all directions from point of stimulation; non-myelinated; one type of cell. Converse vertebrate. Matched points [Max 2]
- (c) (i) As fibre diameter increases speed of conduction increases;

Much more rapid response in myelinated;

Below a certain diameter (1.1 μm) non myelinated faster;
(not: Below a certain diameter no conduction)
Myelinated linear, non-myelinated rapid at start then plateau; [Max 3]
- (ii) Conduct slower than non myelinated. [1]
- (iii) Increase diameter; myelination, higher (body) temperature; longer distance between nodes / fewer nodes.
Saltatory conduction [3]

5. (a) (i) cortex [1]
- (ii) Water has been absorbed / less volume of water; [1]
- (iii) C
B, A
E acc C
F or G [4]
- (iv) A = decrease
C = decrease
D = decrease
E = increase [4]
- (b) (i) Loop of Henle longer;
Counter current multiplier; (not: description)
Creates region of (very) low water potential around loop;
More water reabsorbed from collecting duct;
Reference to low filtration rate; [Max 2]
- (ii) Metabolic water / water from metabolism;
Respiration;
Fats / oils. [2]

6. (a)
- A. Lag phase, Log phase / exponential- term in correct context;
 - B. Induction DNA / gene switching / DNA unzipping;
 - C. Enzyme production/protein synthesis;
 - D. Substrate breakdown / getting used to growth medium;
 - E. Slow population growth;
 - F. Rapid cell division;
 - G. Abundance of nutrients / oxygen / low levels of waste products / no environmental resistance;
 - H. Cell production exceeds cell death;
(not: ref. birth/immigration/emigration)
 - I. Population doubles per unit time;
 - J. Population increases then begins to slow;
 - K. Lack of nutrients / accumulation waste products / environmental resistance; (not: ref space)
 - L. Stationary phase;
 - M. Cell production = cell death; (not: ref birth, penalise once only)
 - N. carrying capacity;
 - O. lack of nutrients / accumulation of waste products if not given as K;
 - P. Death phase;
 - Q. Cell death exceeds cell production;

- (b)
- A. Decomposition / putrefaction;
 - B. Recycling nutrients;
 - C. Breakdown of organic materials into inorganic / suitable e.g.;
 - D. Nitrifying bacteria;
 - E. Nitrosomonas, Nitrobacter;
 - F. ammonium compounds to nitrites;
 - G. nitrites to nitrates;
 - H. ammonium compounds to nitrates if no F/G;
 - I. Nitrogen fixing bacteria;
 - J. atmospheric nitrogen converted into organic nitrogen / e.g.;
 - K. free living azotobacter;
 - L. rhizobium;
 - M. root nodules of (legumes);
 - N. denitrification [Max 8]
 - O. encourage aerobic conditions (to stop denitrifiers) / ploughing;
 - P. drainage for aerobic conditions to stop denitrifiers;
 - Q. grow leguminous crops / add organic waste products / manure / urea etc; [Max 2]

HB4

1. (a) nitrification. [1]
(b) homeostasis. [1]
(c) oxygen debt / deficit. [1]
(d) Gram. [1]
(e) ADH / anti diuretic hormone. [1]

[Total 5 marks]

2. (a) (i) To remove heat generated by metabolism / respiration. [1]
(not maintain constant or optimum temperature)
(ii) To prevent contamination with unwanted microbes/prevents airborne bacteria entering. [1]
(iii) To direct flow of air / oxygen / aerobic respiration / disperses air / oxygen as bubbles through culture medium. [1]
- (b) (i) All nutrients added at beginning of culture / non added during process;
Waste products not removed;
Product harvested at end;
pH not adjusted. [2]
(ii) Penicillin is a secondary metabolite.
Produced after the (exponential) growth phase / during stationary phase.
Fungus produces penicillin when nutrients are depleted. [2]

[Total 7 marks]

3. (a) (i) X glycolysis;
Y Krebs / TCA / citric acid cycle. [2]
- (ii) mitochondrion; matrix. [2]
- (b) A – three
B – two
C – six [3]
- (c) Removal of hydrogen (ions) / dehydrogenation;
From pyruvate / pyruvic acid;
To hydrogen acceptor / NAD;
To form reduced NAD or eq. [2]

[Total 9 marks]

4. (a) Electrons leave chlorophyll molecules / raised to a higher energy level;
pass to / picked up by electron acceptor;
then passes down chain of electron carriers;
held in thylakoid membranes;
energy is released as electrons pass down chain;
used to phosphorylate ADP or eq. [3]
- (b) RuBP combines with carbon dioxide;
forming an unstable 6 C compound;
which splits into glycerate 3 phosphate (GP);
GP is phosphorylated to triose phosphate;
Triose phosphate is converted to glucose. [3]
- (c) active transport;
muscle contraction;
nerve transmission;
synthesis of materials within cells/proteins/mitosis. [2]
- (d) Lipids in food stores in seeds (e.g. olive oil);
Amino acids / proteins for growth. [2]

[Total 10 marks]

5. (a) A – Bowman’s capsule
 B – Loop of Henle
 C – proximal convoluted tubule [3]
- (b) (i) Blood entering Blood leaving
 Oxygenated less oxygen;
 Glucose present none / less glucose
 Urea none / less urea
 Little CO₂ more CO₂
 More salts/sodium ions less salts/sodium ions
 Water less water
 (Any four from 6) [4]
- (ii) urine;
 water, salts and urea [2]
- (c) (i) Contraction of left ventricle / high blood pressure in renal artery;
 Vessel leaving glomerulus is narrower than that entering / afferent arteriole has a wider diameter than the efferent arteriole;
 capillaries in glomerulus increasing pressure (as blood flows through). [2]
- (ii) Dehydration;
 Heart attack / myocardial infarction;
 Haemorrhage / heavy blood loss;
 Atheroma / obstruction in afferent vessel / renal artery;
 Infection of glomeruli. [1]

- (d) organs for sale / exploitation in some parts of the world;
only one functional kidney, risk;
demand for donors;
pressure on potential living donors;
problems associated with genetic screening (for kidney damage);
genetic engineered kidneys;
religious objection qualified. [3]
(not: shortens life expectancy/rejection)

[Total 15 marks]

6. (a) sarcomere [1]
- (b) myosin [1]
- (c) (i) 1. gets shorter / smaller / contracts [1]
2. the actin (filaments) move over the myosin (filaments) /
Invasion of I band by myosin;
and are drawn towards the Z line;
by means of a ratchet mechanism. [2]
- (ii) 1. Stays the same length / no change in length
(not: nothing happens) [1]
2. the A band corresponds to the myosin filaments which
remain in the same position. [1]
- (d) (i) (a small amount of aerobic respiration is possible)
anaerobic respiration;
with the production of lactic acid / lactate;
hydrolysis of ATP;
to form ADP + Pi. [2]
- (ii) increase in number / size of mitochondria;
increase in tolerance to lactate;
number of myofibrils;
glycogen / fat storage;
increases blood supply. [1]

[Total 10 marks]

7. (a) (i) A – cell body
 B – dendrites
 C – myelin sheath
 D – node of Ranvier [4]
- (ii) motor [1]
- (iii) arrow pointing from cell body along axon [1]
- (b) (i) -70mV (must have units) [1]
- (ii) (inside low Na⁺ and high K⁺ / outside high Na⁺ and low K⁺)
 outside of membrane is positive compared to the inside
 (as stated in Q details of resting potential are not required).
 sodium channels open/permeable to sodium;
 sodium ions move into neurone;
 by diffusion;
 creating a positive charge of +40 mV inside the membrane
 membrane becomes depolarised; [4]
- (iii) (Another action potential cannot be generated.)
 Impulses can only flow in one direction (along the axon);
 Limiting frequency of impulses. [1]
- (c) 1. MND: degeneration of motor nerve cells in the brain (and spinal cord);
 2. Parkinson's: death of brain cells producing dopamine
 (a neurotransmitter). [2]

[Total 14 marks]

8. (a) (i) (The following may be labelled on a graph but must include an explanation to gain a mark.)
- A. Lag phase – period of preparation for growth / intense metabolic activity, notably enzyme synthesis / numbers are low therefore rate of multiplication is low.
 - B. Log / exponential phase – no limiting factors / abundant resources / rapid reproduction
 - C. Stationary phase – carrying capacity reached / rate cell division = rate cell death / population has reached maximum size.
 - D. Competition for limited resources.
 - E. Death phase – death rate greater than cell division rate.
 - F. due to a depletion of resources / accumulation of toxins.

[Any 4 from 6]

- (ii) (it is appreciated that in developing countries not all the following hold true but the question covers the overall position of human population growth.)

- G. Drawing of human population curve showing little or low population increase until around 400 years ago, with steep upturn from 100 years ago.
- H. There is no S shape / no stationary phase/still at log phase/not reached carrying capacity
- I. Humans can influence or change the environment / irrigation
- J. Little to fear from predators/no predators.
- K. Considerable advances in food production / overall no limit to resources (not: food readily available)
- L. War / famine / disease have relatively little overall effect
- M. Medical advances e.g. treatment of disease with antibiotics / vaccines
- N. Consequently (in selected parts of the world) people are living longer / reduced infant mortality.
- O. Birth rate is greater than death rate.

[Any 6 from 9]

[Total 10 marks]

8. (b)
- A. Arrival of impulse at synaptic knob.
 - B. alters its permeability allowing calcium ions to enter.
 - C. this causes synaptic vesicle to fuse with pre-synaptic membrane.
 - D. acetylcholine/neurotransmitter is released (into synaptic cleft).
 - E. and diffuses across
 - F. and attaches to (protein) receptor site on the other side / post-synaptic membrane/acetylcholine combines with receptors.
 - G. more permeable/ channels open up (in the membrane)
 - H. sodium ions diffuse/enter into the post-synaptic neurone
 - I. this depolarises the membrane and initiates an impulse / action potential in the next neurone.
 - J. acetylcholine is destroyed by cholinesterase
 - K. ref. reformation acetylcholine/resulting choline and ethanoic acid / acetate diffuses back across the synaptic cleft /ATP is required to reform acetylcholine which is stored in vesicles.

[Any 8 from 11]

- L. act as a cholinesterase inhibitor
- M. acetylcholine remains in the membrane
- N. protein channels remain open
- O. causes repeated firing of the post-synaptic neurone / at neuromuscular junction repeated contraction of the muscle occurs / nervous system becomes overactive / muscles contract uncontrollably.

[Any 2 from 4]

[Total 10 marks]



WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk